UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of	)	**Docket No. 52-011-ESP**
Southern Nuclear Operating Company	)	**ASLBP No. 07-850-01-ESP-BD01**
(Early Site Permit for Vogtle ESP Site)	)	**January 9, 2009**

SOUTHERN NUCLEAR OPERATING COMPANY'S TESTIMONY OF DR. CHARLES COUTANT CONCERNING EC 1.2

I. WITNESS BACKGROUND

Q1: Please state your name, address and current occupation.

A1: My name is Charles Coe Coutant. I am a retired Distinguished Research Staff Member of the Oak Ridge National Laboratory, Oak Ridge, Tennessee. My combined business and home address is 120 Miramar Circle, Oak Ridge, TN 37830-8220. I now serve as a private consultant on matters of aquatic ecology and fisheries biology.

Q2: Please summarize your educational and professional qualifications.

A2: My professional and educational experience is summarized in the curriculum vitae (CV). *See* Exhibit SNC000012 (Dr. Charles C. Coutant Curriculum Vitae). I received a Ph. D. in Biology (focus on ecology) from Lehigh University in 1965. I have conducted thermal effects and other cooling water studies since 1959. For 5 years post doctorate, I studied thermal effects on aquatic life of the Columbia River in Washington. At the Oak Ridge National Laboratory, since 1970, I have conducted individual research on thermal effects, entrainment and impingement on aquatic life, led a team of scientists studying these power plant cooling issues

(for which I have numerous publications listed in my CV), participated in preparation of NEPA Environmental Impact Statements for nuclear power plants for the U.S. Atomic Energy Commission, later the Nuclear Regulatory Commission (NRC), in which issues related to thermal, entrainment and impingement impacts were analyzed (Palisades, Shoreham, Indian Point), as well as for several hydropower facilities (for the Federal Energy Regulatory Commission, FERC). I also have participated in the development of national water quality criteria for temperature (National Academies and the Environmental Protection Agency, EPA) and the interagency (NRC & EPA) implementation document for the thermal effects Section 316(a) of the Clean Water Act. I have assisted numerous electricity generators with aquatic environmental licensing issues, including Virginia Power (now Dominion) with its North Anna Nuclear Power Plant. I have served on several task forces to develop biological criteria for environmentally benign siting, design and operation of power station cooling-water facilities. I helped develop the NRC NEPA implementation rules in my role as a participant in preparation of the initial EISs for the Atomic Energy Commission Division of Regulation (predecessor to NRC). This preceded the formal NRC guidelines now in place.

Q3: Please describe your professional activities.

A3: My professional activities have included active participation in the American Fisheries Society, the dominant professional society for fisheries scientists and managers in North America. I served as President of the Society in 1996-1997, after several years of membership on the Governing Board. I was also President of the Water Quality Section, the Tennessee Chapter, and the Southern Division. For many years I was an active participant in the literature review committee of the Water Pollution Control Federation (now Water Environment Federation), producing annual reviews of thermal effects literature. I have served on panels of

the American National Standards Institute and the American Nuclear Society developing environmental standards for cold shock and entrainment, and of the American Society of Testing and Materials for containment transport models. I am also a member of the Ecological Society of America, in which I was an officer of the Applied Ecology Section. I have served as an advisor to international agencies with respect to power station cooling-water impacts (Germany, Sweden, Canada, New Zealand, International Atomic Energy Agency (IAEA), and Unesco). The IAEA and Unesco activities resulted in reference manuals for siting, design and operation of steam power stations to minimize detrimental aquatic environmental impacts. As a result, I have considerable familiarity and experience with evaluating and considering aquatic impacts from impingement and entrainment and from thermal discharge of cooling water systems.

Q4: Are you familiar with Environmental Impact Statements ("EIS") prepared for compliance with the National Environmental Policy Act ("NEPA")?

A4: Yes; I am familiar with NEPA EISs, both in general and specifically those prepared by the NRC.

Q5: What is the basis of your familiarity with NEPA EISs?

A5: I have participated in the NEPA EIS process since 1971 and in predecessor environmental impact assessments for nuclear power stations since 1967. From 1967-1969, I was the lead aquatic ecologist at Battelle-Northwest (managing contractor for the Atomic Energy Commission's [AEC] Hanford Laboratories) in evaluations of fisheries and other aquatic impacts of proposed alternative nuclear power station sites in the Pacific Northwest. With the 1971 Calvert Cliffs decision that extended the AEC's EIS responsibilities to include non-radiological impacts, I worked with AEC's regulatory staff as a staff member of the AEC's Oak Ridge National Laboratory to develop implementation guidelines and topics for evaluation, including

thermal, entrainment and impingement impacts of the cooling system. I was lead author of aquatic assessments for AEC's EISs for Palisades and Shoreham nuclear power stations in the early 1970s, which were contracted to Oak Ridge National Laboratory. I also participated at that time in preparing EISs for Indian Point 2 and 3. I participated in peer reviews of EISs prepared for other existing or proposed power plants for the AEC and its successor regulatory agency, the Nuclear Regulatory Commission. Most of my AEC/NRC EIS contributions were accompanied by testimony before Atomic Safety and Licensing Boards. These assessments were a valuable complement to the biological research my team and I were conducting on these topics at Oak Ridge National Laboratory.

In the 1980s and 1990s, I participated in ecological analyses of hydropower plants for EISs by the Federal Energy Regulatory Commission, including the Susitna Project in Alaska, the Skagit River Project in Washington state, and Ohio River hydropower development. These EISs were contracted to the Oak Ridge National Laboratory in a manner similar to that used by the AEC/NRC. I also participated in EISs for Department of Energy facilities. More recently, I participated in resolution of aquatic ecological issues related to another Early Site Permit (North Anna additional units) on behalf of the company, Dominion Nuclear North Anna LLC.

Q6: Are you familiar with Southern Nuclear Company's ("SNC's") ESP application for Vogtle Units 3 & 4?

A6: Yes.

Q7: Have you reviewed the Petition for Intervention and supporting documents filed in this proceeding?

A7: Yes.

Q8: Are you familiar with Contention EC 1.2?

A8: Yes. I reviewed the Petition for Intervention, SNC's and the Staff's Responses, the Board's Order admitting EC 1.2 and all of the filings and supporting documents related to the Motion for Summary Disposition of EC 1.2. As admitted, EC 1.2 now reads:

The ER fails to identify and adequately consider direct, indirect, and cumulative impingement/entrainment and thermal effluent discharge impacts of the proposed cooling system intake and discharge structures on aquatic resources.

Q9: Are you familiar with the Vogtle site?

A9: Yes.

Q10: Have you visited the Vogtle site?

A10: Yes, on March 19, 2008, I spent the entire day at the site.

Q11: Please describe your visit.

A11: I flew into Augusta, Georgia, on the afternoon of March 18 and met with SNC staff (Matt Montz, Tom Moorer and others) in the evening to discuss the site visit the next day. We drove from Augusta to the Vogtle site early on the morning of March 19, where we met Tony Dodd of the Georgia Power Environmental Lab, who was conducting the field studies on entrainment and impingement and later the thermal plume monitoring. Mr. Dodd showed me the entrainment sampling nets in their storage location on the site. We visited the intake canal and pump house, and we observed the river itself, which is a single channel with muddy soil banks a few feet high studded with riparian vegetation. We could see the Department of Energy's Savannah River Site (SRS) property across the river and observed the proximity of that site to Plant Vogtle.

Q12: What is the purpose of your testimony?

A12: I will testify regarding the sufficiency and adequacy of the EIS. Specifically, I will testify regarding the general purpose of an EIS (based on my personal experience as both a writer and a reviewer), use of an EIS by the NRC, acceptability of available data for the proposed site (especially data from the Department of Energy's Savannah River Site across the Savannah River from Vogtle), the reasonableness of SNC's and NRC's impact analyses and the value of the present Vogtle units as evidence of small impacts. I will refute the assertions made by the Intervenors, specifically those made through their expert, Dr. Shawn Young. I am providing separate testimony regarding EC 1.3 and EC 6.0.

II. NRC REQUIREMENTS APPLICABLE TO PREPARATION OF EISs

Q13: Please describe your understanding of NRC regulatory requirements and any related NRC guidance applicable to the preparation of an EIS.

A13: The general purpose of an EIS under the National Environmental Policy Act of 1969 (NEPA; Public Law 91-190) is to assist a federal agency in making a reasoned estimate of the environmental consequences of a significant decision or so-called "major federal action." In this case, the major federal action is the proposed issuance of an Early Site Permit. Indeed, such a decision often involves federal licensing of a project. The intent of NEPA is to ensure environmental input into federal decision-making. The intent is not to require conclusive scientific evidence for every question.

The overall federal EIS process is overseen by the Council on Environmental Quality (CEQ), which monitors for technical and legal adequacy of EISs produced by federal agencies such as the NRC. Both CEQ and NRC have implementing rules, which explain how to make estimates of environmental impacts. CEQ rules are found at 40 CFR part 1500. For NRC, these

rules are in 10 CFR Part 51, specifically 10 CFR 51.70 and 51.71, and NUREG 1555, for example, is NRC's standard environmental review plan. Throughout my participation in scoping and writing EISs, it has been consistently clear that absolute certainty about environmental impacts is not required by NEPA, nor by CEQ or NRC implementing regulations.

Q14: Does the NRC or CEQ specify the scientific methods or analyses required to be used in the estimation of the environmental impacts of a project?

A14: No. Neither CEQ nor NRC stipulates what methods are to be used in the estimation of environmental impacts of a project. The NRC's guidance (NUREG 1555 at 6) states simply: "The methods to be used for analysts and staff judgments are objective and based on sound analytical procedures." The operative criterion is whether the agency has considered the relevant and pertinent information within adequate procedures and processes (Gerrard 1993). This criterion has been established over years of peer, administrative, and judicial reviews, in some of which I have been a participant. Although NEPA EISs rest on readily verifiable facts, they contain heavy doses of scientific opinion about both facts and the methods used to arrive at them. For the NRC, the goal is to provide "a reasonable estimate of the impact to a resource" (NRC Review Standard RS-002). It is left to staff judgment what method is used to make a reasonable estimate.

Q15: In your view, is the use of existing data sources appropriate when preparing an EIS?

A15: Yes. The intent of NEPA, expressed in the NRC implementation rules (NUREG-1555, for which I helped develop predecessor documents in the 1970s), is to require the synthesis of relevant and pertinent environmental information, often derived from sources other than the project applicant (Caldwell 1993). The clear intent of NEPA is to draw upon science as an

informant and corrective for public policies impacting on the environment. NEPA requires a systematic, integrated, interdisciplinary use of sciences and information that could reveal the probable effects of the agency's action that significantly impact the environment. Reliance on data collection performed by reputable agencies and organizations, whose methods can be assessed with the results, is just as valid an approach to a NEPA analysis as an applicant performing its own studies. Importantly, in many disciplines, the recency of such data is not particularly significant. Accordingly, even though a prior study would by definition pre-date a new, applicant-performed study, this may have little or no bearing on the usefulness or validity of the data.

Q16: In your opinion, is it appropriate to synthesize data collected for other purposes into a "model" for the specific project when preparing an EIS?

A16: Yes. Much scientific information that is relevant and pertinent to evaluating environmental impacts of any project is developed for other purposes. In my view, a unique attribute of an environmental impact analyst is an ability to see the broad picture from information with many origins. Most of the papers in the book *Environmental Analysis: The NEPA Experience* (Hildebrand and Cannon 1993) reflect application of information from a wide variety of sources to environmental impact analysis. Even when an applicant obtains site-specific environmental data, these data need to be evaluated in the context of scientific understanding obtained from many sources. Most EISs aggregate existing information into "models" that are used to make predictions about the environmental impacts of a proposed action (e.g., Stalnaker 1993, Adams et al. 1993). Some models are sophisticated, computerized calculation schemes whereas other models are simply professional opinion about how systems

work (e.g., Bruns et al. 1993). No matter which model is used, it is important for the EIS analyst to have visited the site to place the diverse information into a geographical and spatial context.

Q17: Are reasonable estimates ever appropriate in preparing an EIS?

A17: Definitely. In my experience, some environmental attributes important for carrying out environmental impact analyses are too variable for detailed, empirical data to be directly useful, and thus reasonable estimates based on a broader context are not only proper, but are essential. Typically, EISs use generalizing assumptions, such as uniform distribution at a conservative density, for analyses that are relevant and pertinent, although not precisely matching actual field data. The purpose is to test whether reasonable assumptions indicate a sufficiently large environmental impact for continued concern. In my experience, this is a common and accepted method of assessing impacts or effects in almost any ecological discipline, and it is an appropriate methodology for a NEPA analysis.

III. REVIEW OF THE EIS FOR VOGTLE UNITS 3 & 4

Q18: Have you reviewed the EIS prepared for Vogtle Units 3 & 4?

A18: Yes; SNC asked me to review the NRC's EIS, its supporting documentation in the form of relevant literature, other scientific and fisheries-management literature, SNC's Environmental Report and SNC's and the staff's responses to the Board's Requests for Additional Information.

Q19: In your opinion are the analytic methods used in the EIS for Vogtle objective and based on sound analytical procedures?

A19: Yes.

Q20: What is the basis for your opinion?

A20: The EIS appropriately relies on generally accepted scientific information. The analysis is consistent with that which I would have done and the conclusions are reasonable and supported. In my opinion, scientific information developed by the Department of Energy's Savannah River Site, by the Academy of Natural Sciences of Philadelphia in its periodic biological surveys of the Savannah River since the 1950s, by the Georgia and South Carolina departments of wildlife and fisheries, US Fish and Wildlife Service, US National Marine Fisheries Service, the US Geological Survey, and by independent investigators successfully meets the "general acceptance test" of available information for use in an EIS. In the aggregate, these data are highly representative of the current aquatic conditions at the Vogtle site. The NRC has appropriately conducted independent calculations of effects of Vogtle Units 3 & 4 operation and combined Vogtle Units 1-4 operation on aquatic resources, such as characterizing the amount of water withdrawal and entrainment at the intake (e.g., EIS at 5-9) and the physical dimensions of the thermal plume using the CORMIX model (EIS at 5-17). The EIS uses the appropriate combination of summarizing available relevant literature from multiple sources, conducting independent calculations of key impact features, and developing informed professional judgment concerning the results of the analyses.

Q21: What is your opinion regarding the adequacy of the analysis in the EIS?

A21: The EIS describes an analysis that is thorough, uses standard methods, and is consistent with the level of detail that the estimated impacts warrant.

Q22: What is the basis of this opinion?

A22: As I have responded above, the guidance for NEPA EISs by NRC and CEQ points to an evaluation that identifies the relevant types of impact that could occur, assembly of relevant and scientifically acceptable information from available sources, use of reasonable

analytical methods appropriate for the type of impact, and a reasoned judgment of whether the impact is SMALL, MODERATE or LARGE. In my independent review of available data, some of which goes beyond that cited specifically in the EIS, I have affirmed the appropriateness of the literature cited in the EIS and the conclusions reached by NRC staff. The guidance does not specify that each identified risk for impact be analyzed in fine detail with extensive field studies at the site of the proposed project. The EIS provides appropriate discussion for the low level of impacts that the analysis determined. In my experience, decision-makers have sought plain-language presentations in EISs that summarize the analyses with minimum unnecessary detail and technical jargon. I believe that the EIS by the NRC staff accommodates this desire. The data I reviewed is the type of data I would use to reach the conclusions required by NEPA.

Q23: How is SNC's operating experience at Vogtle Units 1 & 2 relevant in estimating anticipated environmental impacts of Units 3 & 4 on the Savannah River?

A23: The apparent lack of significant aquatic environmental impacts from Vogtle Units 1 & 2 provides a commonsense indication of similarly small impacts for the proposed Units 3 & 4. The proposed new units would use the same EPA-approved closed-cycle cooling employed at Units 1 & 2.

As noted in the ER, EPA pre-approval of a technology generally implies acceptability of the small residual impacts. *See* Exhibit SNC000001 (Environmental Report for Southern Nuclear Operating Company's Vogtle Early Site Permit Application) at 5.3-1, *citing* 40 C.F.R. § 125.94(a)(1)(i). I have personally been involved with EISs of power stations with once-through cooling for which the preferred alternative by the regulatory agencies and the environmental groups was ultimately the closed-cycle cooling system already used at Vogtle Units 1 & 2 and proposed for Units 3 & 4.

Although detailed entrainment and impingement studies were carried out at Units 1 & 2 only this past year, *see* Exhibit SNC000005 (Entrainment Assessment at the Plant Vogtle Electric Generating Plant (October 2008))) and SNC000004 (Interim Report of Fish Impingement at the Plant Vogtle Electric Generating Plant (January 2009)), some pertinent types of impact would have been evident earlier if they had occurred in any event. For example, if significant numbers of impinged fish had been observed by screen-maintenance personnel, they would have been reported in accordance with NRC reporting rules; they were not seen and reported. No significant changes in aquatic populations that one might reasonably attribute to a cooling water system at Vogtle have been observed in periodic biological surveys of the river by DOE contractors at the Savannah River Site, the Georgia and South Carolina departments of natural resources, other agencies or universities. Therefore, SNC's citation in the ER and NRC's citation in the EIS of the apparently benign cooling system at Vogtle Units 1 & 2 is, in my judgment, a valid basis for concluding that the anticipated scope of environmental impacts of the proposed Units 3 & 4 on the Savannah River would be small or minor.

Q24: Did your visit to the Vogtle site shape your opinion of your review of the EIS?

A24: Yes. It is helpful to view the actual character of the site to be able to assess the information and analysis in an EIS and other literature in context. Units 1 & 2 were operating at the time of my visit, and I was able to observe many of the actual bases for the issues raised by intervenors, including the intake and discharge structures, the proximity to the SRS, and the flow of the river. Specifically, I was shown the entrainment sampling nets in their storage location on the site, and Tony Dodd demonstrated how they operated and how samples were taken. We visited the intake canal and pump house for Units 1 & 2, which are similar to those for the

proposed Units 3 & 4. We observed the collection basket containing debris from the routine screen washings over the several days prior to our visit. The plant staff conducted a screen wash typical of what is done for impingement sampling, but no additional fish were collected.

As we walked around the intake canal, we discussed at length the difficulty of sampling plankton at that location with its slow water velocities that prevent the use of the plankton nets used in the river. I agreed that a pumped sample would be appropriate and that safety concerns mandated it be done from the top of the steel pilings that lined the canal. We observed the canal entrance with its debris boom at the surface and sill at the bottom designed to prevent water (and organism) withdrawal from the very bottom of the river (although the sill itself was not visible underwater).

From the vantage point of the intake structure at the mouth of the canal, we observed the river itself, which is a single channel with muddy soil banks a few feet high studded with riparian vegetation. I understand that this was typical of the river through the Vogtle property. We could not see the thermal discharge plume from this vantage point because of the large amount of shoreline vegetation. We also walked through some of the site outside the generating station to view the general terrain.

In general, my observations were consistent with the analysis and conclusions which were presented in the EIS.

IV. RESPONSE TO CONTENTION EC 1.2

Q25: Do you agree with the assertion that the ER/EIS fails to identify and adequately consider direct, indirect and cumulative impacts of the proposed cooling system intake and discharge structures on aquatic resources?

A25: No.

Q26: Please state the basis for your conclusion.

A26: The iterative process of the NRC staff's data gathering and analysis, including the SNC's ER, NRC staff questions, and supplemental submissions by SNC has ensured that the direct, indirect, and cumulative impacts have been addressed specifically in the EIS. In my opinion, the EIS covers these topics in plain language and sufficiently completely. For direct impacts to water resources (including the cumulative impacts of both existing and proposed units and other water users), see EIS at 5-5 through 5-21, and EIS Section 7 (at 7-19 through 7-25). For indirect impacts to aquatic ecological resources, including cumulative impacts of both existing and new units, see EIS at 5-29 through 5-37 and summary at 5-38 to 5-39, with cumulative impacts at 7-19 through 7-25. In each case, the EIS (in the typical format) provides the background information and calculations in Section 2 (water resources at 2-17 through 2-44; ecological resources at 2-72 through 2-95). SNC has carried out several field studies prior to this hearing to further expand our understanding of the likely scale of impacts and to confirm the low levels of impacts as concluded in the EIS. Recall that the objective of an EIS is to provide a summary of relevant analyses and reasoned professional judgments about the types and severity of impacts that could affect the federal action (in this case, the issuance of an Early Site Permit), not to provide a detailed treatise on aquatic resources and potential impacts I cannot identify anything additional which would be necessary to make the analysis suitable for that purpose or would change NRC's conclusions reached in the EIS.

Q27: In your opinion, does plant design have any effect on aquatic impacts?

A27: Yes. From a scientific standpoint, design features of the cooling system and water intake can minimize mortalities to aquatic organisms from impingement on intake screens

and entrainment through the cooling system to generally accepted low levels. A fair amount of my career has been devoted to developing biological design criteria for power plant cooling systems, through research, analyses, reviews, and development of design and operation standards (see my professional activities, above and in my CV).

As noted in the ER (with supplements) and in the NRC's EIS, closed-cycle cooling of itself greatly reduces potential for mortalities. In contrast to an open-cycle, once-through cooling system used at many power stations, the closed-cycle cooling system chosen for the proposed Vogtle units will reduce water withdrawal (and thus the numbers of drifting organisms entrained) by more than 95 percent. This reduction is greater than the Environmental Protection Agency's previously proposed guidelines of 60-90 percent reduction (draft § 316(b) Phase II Rule, now stayed in favor of Best Professional Judgment).

The plant's proposed intake screens are to be located in an offshoot canal perpendicular to the Savannah River, similar to Units 1&2, where flow velocities are generally below 0.5 ft/sec, the EPA criterion for protection against impingement (to which I contributed; Coutant et al. 2000). A submerged weir in the intake impedes benthic fish from entering the intake canal. The plant includes many of the biological design criteria that the research program I headed at Oak Ridge National Laboratory sought to identify. The NRC staff, in the EIS, identifies the aquatic biota potentially at risk, using studies of riverine biota carried out by the Academy of Natural Sciences of Philadelphia and other contractors of the SRS, as well as other federal and state agencies. Thus, in my professional opinion, the design features of the cooling system make significant mortalities of Savannah River biota from entrainment and impingement unlikely, and lessen the need for further site-specific biological studies. The assessments and conclusions

provided by SNC in its ER and supplements and by the NRC staff in the EIS are scientifically appropriate and sufficient to satisfy the requirements of NEPA.

Q28: On what information does the EIS rely to conclude that impacts from impingement and entrainment will be small?

A28: The EIS relies on studies done for the existing plant's EIS and Clean Water Act 316(b) compliance in the 1980s; other prior research on impingement and entrainment in the river reach such as that sponsored by the SRS; use of closed cycle cooling at Vogtle; information on river dimensions and flows at Vogtle; design features of the existing and proposed units including low intake canal velocity, low thru-screen velocity, design of intake canal including bottom weir; results of reports to NRC pursuant to App. B. of the Environmental Protection Plan for Units 1 & 2; site visit on March 8, 2007 and March 19, 2008, and impingement and entrainment studies that had begun at the time of preparation of the EIS. Taken together, these support the conclusion that impacts will be small.

Q29: How does the weir affect impingement or entrainment?

A29: As described in the drawings of the intake (EIS at 3-10), the weir would be an elevated boundary between the river and the intake canal. The weir would prevent water and organisms flowing along the river bottom from entering the canal except by rising above the weir. It is presumed that bottom-dwelling fish and invertebrates would be reluctant to rise above the weir and enter the intake. This should reduce the number of fish susceptible to impingement that would enter the intake canal. It may also reduce the number of drifting organisms such as fish eggs and larvae and invertebrates that may be concentrated in bottom waters according to the studies in the Vogtle vicinity by SRS's Paller (1984, 1985, 1986, 1990, 1992 and 1995) and by Nichols (1983). As discussed with NRC on the site visit, the physical integrity and

effectiveness of the weir have not been measured at the Unit 1 & 2 intake but remain appealing for the proposed units based on general principles. The results seen in the SNC 2008 field studies suggest some mechanism, likely the weir, is effective for excluding many drifting organisms seen in river samples.

V. RESPONSE TO SPECIFIC BASES OF CONTENTION EC 1.2 REGARDING BASELINE AQUATIC DATA

Q30: Does the EIS include information related to the life history stages that occur near the Vogtle site?

A30: Yes. In section 2.7.2.1 where major aquatic ecosystem components are described (at 2-74 through 2-81) and the life cycles of important fish species are summarized (at 2-81 through 2-93).

Q31: Is it necessary to present more detailed data in an EIS on fish life history stages that occur near the proposed facility, migration timing of each species' life history, distribution patterns in the immediate vicinity of the plant, and population numbers, as asserted most recently by Dr. Young in his November 13, 2007 Affidavit (page 3, ¶ 6 and 8)?

A31: Although this level of detailed, site-specific information can be useful in refining estimated impacts of a proposed facility which are determined to be MODERATE or LARGE, it is not a required part of the text of an EIS. "[T]he degree of detail should be modified according to the anticipated magnitude of the potential impacts." (NUREG-1555 at 2.4.2-2). The NRC in its guidance summarizes the Council of Environmental Quality's guidance that an EIS should "emphasize the issues that are significant and reduce emphasis on other issues and background material" (NUREG-1555 at 4). Provision of an encyclopedia of this information for each of the 95 local fish species listed by Marcy (2005) and in Table 2-7 of the EIS would be burdensome

for a reader of a decision document like an EIS and would not be helpful. This is particularly true where the impacts are SMALL. General life-history information on the most-relevant species of fish can be obtained from standard references and research literature (especially for nearby locations) and applied to the local situation by knowledgeable analysts preparing the EIS.

Moreover, the EIS does provide information of the sort desired by Dr. Young, largely from literature references to local studies by others (as is allowed by NUREG-1555 at 2.4.2-3). Relative abundances of fish species are provided from studies by the Academy of Natural Sciences of Philadelphia (ANSP) at several locations near the Vogtle facility (e.g., EIS at 2-80). Dominance of the river ichthyplankton by American shad eggs and larvae and gizzard shad and threadfin shad from the oxbow spawning areas is indicated from literature references (EIS at 2-21). Information on vertical distribution of drifting eggs is provided where available (EIS at 2-81). Details of local life history, population sizes and relevance to occurrences at the Vogtle site are given for major species American shad (EIS at 2-82), and striped bass (EIS at 2-84), and species of concern robust redhorse (EIS at 2-88) and shortnose sturgeon (EIS at 2-89). I can tell from the EIS that NRC considered the life history stages in reaching its conclusions and that they reached the appropriate conclusions. I agree with the authors of the EIS that the provided information is sufficient for a reasonable assessment of likely impacts on the NRC scale of SMALL, MODERATE or LARGE (EIS at 1-4). It is apparent to me that life histories were considered and the conclusions reached are consistent with the analysis I would have done.

Q32: In your opinion, has the EIS and its supporting ER relied disproportionately on studies by the ANSP for the Savannah River Site and given them too much weight in lieu of special studies by the applicant or others at the Vogtle location (as opined by Dr. Young in his November 13, 2007 Affidavit, page 7, ¶ 17 and 18)?

A32: No, I do not believe the ANSP studies were used inappropriately or given too much emphasis.

Q33: What is the basis for your opinion?

A33: The long-term studies by the ANSP for the Savannah River Site (since the 1950s) are a valuable resource of information about the Savannah River ecosystem. They provide empirical data on many aquatic life forms, including fish. When I visited the Vogtle site, the nearby location of the SRS relative to Vogtle and to the ANSP sampling locations was apparent. The research plan for establishing the baseline for the Savannah River near Vogtle would be nearly the same as for the SRS. In other words, it is very helpful to any analysis of impacts from Plant Vogtle to have the benefit of the SRS data.

But these studies were just one source of information used in the EIS. Other relevant literature was used extensively, as referenced in the EIS. For example, discussions of American shad (EIS at 2-82), striped bass (EIS at 2-83), and shortnose sturgeon (EIS at 2-89) used data from management agencies such as the NOAA National Marine Fisheries Service, Atlantic States Marine Fisheries Commission, and Georgia Department of Natural Resources as well as literature publications from individual authors associated with a variety of institutions. These documents collectively provided much of the information on the affected aquatic ecosystem of the middle Savannah River and near the Vogtle facility. I reviewed these and other pertinent documents in my independent review. *See* Exhibit SNC000013 (Literature References for EC 1.2 Testimony by Dr. Charles C. Coutant). Certainly, they provide a broader perspective of the river ecosystem than would have been obtained by only detailed surveys at the existing Unit 1&2 location and the site proposed for Units 3&4.

Q34: Do you agree with the EIS that the Savannah River at the Vogtle site is "unremarkable," that is, not an especially important habitat for fish and aquatic life, as contested by Dr. Young (November 13, 2007 Affidavit ¶29)?

A34: Yes, I agree with this evaluation.

Q35: On what basis do you agree?

A35: Although, as Dr. Young asserts, all reaches of a river are important to some extent for the "river continuum" of geomorphic processes that continually occur and the organisms living in the river, the NRC guidance (NUREG-1555) requires the identification of *especially important* habitats for both desirable and nuisance species. The EIS correctly identifies the river near Vogtle as a migratory corridor, including the upstream migrations of adult anadromous fishes and the downstream drift and migration of early life stages. It also describes resident species of fish and invertebrates (e.g., freshwater mussels). These features are characteristic of most coastal plain rivers. I understand the staff's use of "unremarkable" was to convey a response to the NRC guidelines to the effect that the staff did not identify other special characteristics of the river reach near the Vogtle facility that demanded detailed attention, such as specific spawning beds, nursery areas, mussel beds, or macrophyte beds. During my site visit, I witnessed the river to be in general accord with the staff's characterization.

Also, at the request of SNC, I conducted an independent literature review of the middle Savannah River and its key biological resources to assure myself that the reach near Vogtle is not a critically important habitat. I retrieved primary scientific literature and management documents (such as resource planning documents by the US Fish and Wildlife Service and US National Marine Fisheries Service) that could form a basis for my opinion. *See* Literature

References for EC 1.2 Testimony. None of these documents identified the Vogtle reach as especially important except for migrations and local movements.

Q36: Do you agree with Dr. Young's assertion that the EIS does not quantify or describe systematically the species composition and habitat in the vicinity of the intake and cooling structures, including shortnose sturgeon, American shad and blueback herring?

A36: No.

Q37: What is the basis for your conclusion?

A37: As noted above, the EIS describes the aquatic ecology of the site for both aquatic communities (at 2- 72 through 2-81) and important species (at 2-81 through 2-93). There are no critical habitats as designated by FWS or Essential Fish Habitat designated by NMFS (EIS at 2-85). Shortnose sturgeon (EIS at 2-89 through 2-93), and American shad (EIS at 2-82) are described as are other important species such as striped bass (EIS at 2-83 through 2-85), American eel (EIS at 2-82 through 2-83) and robust redhorse (EIS at 2-88 through 2-89). The species are grouped according to reasons for importance, including commercial and sports importance and threatened or endangered status. Quantitative data are given when available (e.g., locations of peak numbers of striped bass eggs and larvae; EIS at 2-84). While blueback herring was not discussed separately, in my opinion, this is not a significant omission, because its life history and environmental sensitivity are similar to American shad. As noted in answer to a previous question, it is my opinion that without question the essential information is given for estimating the general magnitude of effect on NRC's scale of SMALL, MODERATE, or LARGE, as required in NRC guidance for NEPA assessments. Further, as stated above, it is clear to me that the information relied on and presented in the EIS is highly representative of the

current conditions at the Vogtle site. This is true even though some of the information was centered, for example, across the river at SRS.

VII. RESPONSE TO SPECIFIC BASES OF CONTENTION EC 1.2 REGARDING IMPINGEMENT/ENTRAINMENT AND THERMAL IMPACTS

Q38: Do you agree with Dr. Young's assertion that the EIS should have included empirical data (i.e. field studies) on the existing units' impact on the level of mortality from impingement and entrainment?

A38: No.

Q39: What is the basis for your conclusion?

A39: While it is always nice to have "more data," such field studies are not required when there are other sources of information representative of the conditions at the site that are available for conducting a reasonable analysis. A considerable amount of existing data was available to the NRC already. As noted in the EIS (at 2-93), the NRC does not impose monitoring requirements for aquatic impacts. This responsibility falls to the EPA and states under the NPDES program of the Clean Water Act. They did not require such monitoring. The NRC merely requires notification of "unusual or important environmental events" such as fish kills or impingement events. There were no such notifications. In my opinion, the analysis is sufficiently complete without "more data" and the conclusions reached are proper.

Q40: Do you agree with Dr. Young's assertion that the EIS does not include data on mortality rates from seasonal field studies on impingement and entrainment at the existing structures?

A40: Yes, but this is not a flaw in the EIS analysis because such additional studies were not essential to assess the impacts for the purposes of NEPA. Also, the EIS (at 2-94) includes

recognition of field studies by SNC in 2008 on entrainment and impingement. Data from these studies was not available for the EIS, but they are provided for this hearing (appended to the testimony of Matthew Montz and Tony Dodd). The field studies by SRS personnel and contractors provided data on a nearby location that is adequate for the EIS.

Q41: Are you familiar with the 2008 field studies by SNC?

A41: Yes. At SNC's request, I worked with their staff and Tony Dodd of the Georgia Power Environmental Lab to prepare a study plan to examine entrainment and impingement at the intake for units 1 & 2 and the adjacent river, as referenced in the EIS, e.g., at 5-31 and 5-32. The entrainment and impingement studies began in March 2008. The entrainment study was concluded in late July when all but occasional drifting early life stages had passed the site. The impingement study is continuing and will cover an entire year. As I noted in my description of the site visit (above), the studies benefited from scrutiny by NRC staff on the site visit in the initial stages of implementation. The studies of both impingement and entrainment are presented in reports which are attached to the testimony of Tony Dodd and Matt Montz.

Q42: Have you reviewed these reports?

A42: Yes.

Q43: In your view, are these the result of legitimate scientific sampling and collection?

A43: Yes. SNC staff, Tony Dodd of Georgia Power Environmental Lab and I developed a study plan to meet the scientific objectives and use scientifically justified sampling equipment and methods. The entrainment study sampled both the intake and the river at several locations to identify non-uniform distribution of drifting organisms in the source water. Mr. Dodd contracted with Normandeau Associates to identify and count the organisms in the

entrainment samples. Impinged fish were collected from the operating intake screens. Mr. Dodd and the staff of his lab identified the impinged organisms. The NRC staff evaluated and approved our study plan at the outset of the study. The study was conducted with strict quality assurance to ensure that it was, indeed, legitimate scientific sampling, collection, sample handling, and sample analysis.

Q44: Can you summarize the entrainment sampling and its results?

A44: The entrainment sampling and analysis consisted of two parts: (1) sampling the drifting fish eggs and larvae (ichthyoplankton) in the source water of the Savannah River at the Vogtle site, and (2) sampling for those same organisms in the water of the intake canal immediately upstream of the intake pumps for the cooling tower make-up water.

The source water of the river was sampled during the spring fish reproduction season, March 18-July 29, at two transects, one about 300 ft upstream of the present intake for Units 1 & 2, and the other another 0.3 mile upstream at the location of the proposed intake for Units 3 & 4. Each transect included a center-channel station and stations about 30 feet from each shore. Paired plankton nets were towed in the river current behind an anchored boat, starting near the bottom and progressing every 5-10 min to the surface at 1-meter intervals. The environmental conditions (e.g., river stage, temperature) were recorded for each sampling event. Densities of eggs and larvae were calculated from the counts in the samples and the amount of water filtered through the plankton net. The study showed a diverse assemblage of drifting early life stages, including 23 taxa groups with 16 of them identifiable to species. About 62% were eggs, with the remainder being yolk-sac or post-yolk-sac larvae. Unidentified minnows as a group were the most abundant over the entire sampling period followed by American shad and unidentified herring family (shads). Peak abundance was April 23 and May 8, with a few yearling or older

fish caught in early June through mid July. There were more organisms collected at night than in the day. American shad, a species of special interest, occurred nearly exclusively as eggs, with an early May peak in abundance. Unidentified species of darters were more abundant at the location of the proposed intake for Units 3 & 4 than near the Unit 1 & 2 intake. All densities were rather low, ranging from about 8 organisms per 1,000 m3 in late July to about 659 per 1,000 m3 in late April.

The intake canal ichthyoplankton was also sampled March through July essentially simultaneously with the river sampling. A pump collection system (water pumped from the canal was filtered through a plankton net) was needed there because the current velocities in the canal were too low to permit use of the plankton nets in the canal. Comparison of pump and net collections taken simultaneously in the river indicated that both methods were comparable when viewed in terms of types and numbers of organisms caught per unit volume of water. There were significantly fewer organisms in the canal water than in the river, and the taxa were different. Yellow perch yolk-sac and post-yolk-sac larvae were most abundant, occurring from mid March through April. A few sucker post-yolk-sac larvae (mid March to late April) and sunfish yolk-sac and post-yolk-sac larvae (mid June through late July) were also found. Most organisms were collected at night. Daytime egg and larval density varied from 0 (zero) organisms/1000 m^3 to approximately 18.1 organisms/1000 m^3 (late March). Nighttime density varied from 0.01 to 29 organisms/1000 m^3. For the entire study period, mean density in samples was approximately 11.3 organisms/1000 m^3. There were no listed species found.

The densities of early life stages of fish in the intake canal allowed calculation of the annual entrainment rate and comparison with the numbers of early life stages passing in the river. The study estimated that annually the Plant Vogtle Unit 1 & 2 intake removed 315,641 +/-

13,261 (95% confidence interval) organisms. Plant Vogtle's mean daily make-up water intake pumping flow (241,000 m^3) represented approximately 2.1 percent of the mean daily flow (11,402,000 m^3) in the Savannah River at Plant Vogtle based on flow records during the study period. Estimated daily entrainment rate is 1,302 organisms [eggs and larvae]) whereas the estimated daily source water drift abundance is 312,039 organisms.

Q45: What do these entrainment results mean?

A45: First, the numbers of organisms entrained, regardless of composition, is exceedingly small in relation to the numbers passing in the river. Second, the species composition of ichthyoplankton in the canal indicates that the river ichthyoplankton is not drawn into the canal in proportion to its occurrence in the river water or if it is, it is not entrained into the cooling water makeup flow. The results of this study through the full 2008 fish reproduction season fully support the EIS conclusion that the impacts of entrainment at the proposed intake for Units 3 & 4, designed similarly to that for Units 1 & 2, will be SMALL. Likewise, the study results, if doubled to represent both intakes operating, would show a cumulative impact that I believe is still SMALL.

Q46: Can you summarize the impingement sampling and its results?

A46: Screen wash from the intake structure traveling screen system was sampled twice per month from 10 March to the present. Samples were collected with a framed net (6 ft x 6 ft x 6 ft mesh bag) that intercepts screen-wash water entering the screen wash pit. The collection net is constructed of ¼-inch nylon mesh netting in order to ensure collection of any organisms that would have been collected on the 3/8-in-mesh traveling screen. Each impingement sampling event represents a 24-hr collection period split into two approximately equal 12-hr samples (yielding a day vs. night sample). The screens were rotated and the system flushed prior to the

measured sampling time. Fish and shellfish were separated from organic debris such as aquatic weed fragments, leaves, twigs, relict and sometime live shells of Asian clam. Sample organisms were then sorted by species, enumerated, weighed and measured.

The report provided results through December 2008, although the study is continuing until March 2009 (ten months of the intended twelve month study period has elapsed). A total of 146 organisms were collected, representing 21 taxa (19 fish and 2 crustaceans). No protected species were collected. Sunfishes were the most abundant fish family. The most numerically dominant individual species so far include spotted sunfish (38.9 %), white catfish (8.9 %), and hogchoker (10.8 %), mostly all young of the year. The two crustaceans include two specimens of the common shore shrimp and three specimens of a freshwater crayfish still unidentified to species level. Total biomass amounted to about 1.9 lb, with the sunfishes accounting for over half of the biomass. Two large fish (a gizzard shad and an injured black crappie) contributed disproportionately to the biomass. Slightly more than half of the impinged specimens were caught at night. The extrapolated impingement number for the 10-month period is 1,453 fish, with an upper 95% confidence level of 1,941. For biomass, the extrapolation is about 17.3 lb with an upper 95% confidence limit of about 23.3 lb.

Q47: What do these impingement results mean?

A47: Impingement occurs at a very low rate and consists mostly of a few young-of-the-year fish plus occasional large fish that already may be incapacitated. The impact for the 10 months of study through December 2008 fully supports the EIS conclusion that impingement risks of an intake for Units 3 & 4 designed similarly to that for Units 1 & 2 are SMALL. If the impingement study results were doubled to represent both intakes operating, it is my opinion that the EIS is still correct in estimating that the cumulative impact would be SMALL.

Q48: In your view, is there any benefit to continuing the entrainment and impingement sampling year around?

A48: There would have been no benefit from continuing the entrainment sampling because the well-known spring and early summer occurrence of drifting early life stages of the major fish species is complete by August. This was confirmed before the 2008 entrainment sampling was discontinued. However, impingement can occur at any time of year. Therefore, although it is reasonable to conclude impacts will be SMALL because there is no suggestion from past impingement observations that impingement impacts would be both highly seasonal and concentrated during the fall and winter, the impingement study is still planned to continue until March 2009.

Q49: Do you agree with Dr. Young's assertion that the EIS does not include mortality rate data from SRS field studies on entrainment?

A49: No.

Q50: What is the basis for your conclusion?

A50: Section 5-32 of the EIS includes this information.

Q51: In your opinion, does the statement quoted by Dr. Young from Marcy et al. (2005) in item 19 of his November 13, 2007 Affidavit (at 8) provide a causal link between entrainment and impingement in cooling water and effects on fish populations in the middle Savannah River?

A51: No, I do not believe it does.

Q52: What is the basis of that belief?

A52: The paragraph quoted is a general statement describing entrainment and impingement. The reference cited by Marcy et al. (2005) is Schubel and Marcy (1978), a book

on entrainment in which I was an author of chapters. The only linkage between Savannah River fish populations and entrainment or impingement along the river is the statement regarding the volumes of cooling water flows for the DOE Savannah River Site and Plant Vogtle. The quotation selected by Dr. Young does not provide any evidence of a causal link.

Q53: Are Dr. Young's assertions valid regarding the need for on-site field studies of the riverine ichthyoplankton (fish eggs and larvae) in relation to impacts of entrainment in the Vogtle cooling system (Affidavit of November 13, 2007, pages 3-7, ¶ 7, 9, 10, 11, 15, 16)?

A53: No. The information in the EIS provides an adequate basis for estimating impacts on the NRC scale of SMALL, MODERATE or LARGE (EIS at 1-4). The EIS uses the on-site studies for the operating permit for Units 1 and 2 of fish eggs and larvae by Wiltz (1983) and studies of macroinvertebrate drift by Nichols (1983) as well as several studies by Paller of fish eggs and larvae at the adjacent SRS. These studies identify distribution patterns of organisms and design features of the intake that minimize the likelihood of entrainment (EIS at 5-31). There is no reason to believe anything has changed that would affect the continued validity of this information.

However, the applicant has supplemented and validated the earlier literature on riverine ichthyoplankton and ichthyoplankton entrainment in the intake flow with field studies at and near the existing Units 1 & 2 intake and proposed Units 3 & 4 intake, as described above in response to Q 41-44 and referenced in the EIS (at 2-94). Riverine ichthyoplankton (including lateral and vertical distribution) and entrained ichthyoplankton were studied in the spring and summer 2008. A report is provided as an attachment to the testimony of Matthew Montz. This study provides additional information of the sort Dr. Young desires that could be used by the

Board and in the later stages of permitting by the NRC and Georgia (for NPDES permit). As noted above, the results of the entrainment study show that entrainment of ichthyoplankton from the river is actually less than the analysis in the EIS assumed.

Q54: Are Dr. Young's assertions valid regarding the need for on-site field studies of the impingement on intake screens of the Vogtle cooling system (Affidavit of November 13, 2007, page 6, ¶ 14, 15)?

A54: As with entrainment, the information in the EIS provides an adequate basis for estimating impacts (EIS at 1-4). Any large-scale impingement problem is generally highly visible at power stations because dead fish accumulate to nuisance proportions in trash collection baskets. This would have been seen at the Vogtle Unit 1 and 2 intake by maintenance personnel and reported to the NRC, but as the EIS indicates, it did not occur. However, the applicant has supplemented and validated the earlier literature on impingement with field studies at the existing Unit 1 & 2 intake, as described above in response to Q 41 and Q 46-47 and referenced in the EIS (at 2-94). Impingement has been sampled systematically since early Spring 2008 with an expected 1-year duration. A preliminary report is provided as an attachment to the testimony of Matthew Montz and Tony Dodd. This study already provides additional information of the sort Dr. Young desires that could be used by the Board and in the later stages of permitting by the NRC and Georgia (for NPDES permit). The results over spring, summer and fall confirm the estimation in the EIS that impingement at Units 1 & 2 is very low, amounting to few numbers and a small biomass, and that impingement at the proposed units would be similar.

Q55: Do you agree with Dr. Young's assertion that the EIS does not address potential impacts on the aquatic drift community from the cooling system thermal discharges or discuss the thermal impacts on larval and juvenile American shad?

A55: No.

Q56: What is the basis for your conclusion?

A56: The EIS estimates impacts to the drift community based on the minimal size of the thermal plume in relation to the river cross section and the low discharge temperatures, and judges the impact small for any organisms passing through the plume or needing to swim around it (EIS at 5-33). In my opinion, this is reasonable. Had the thermal plume covered a much larger percentage of the river with temperatures much more above ambient than expected, or had temperatures been within the range of lethal doses of temperature and duration of exposure for larval and juvenile American shad, then a more extensive analysis might have been justified for the EIS. To test the validity of the analysis in the EIS, I performed such a detailed analysis. I found from the scientific literature that, for example, it would take 30 minutes of exposure to water temperatures 12°F (6.7°C) above an ambient of 68°F (20°C) to cause 50% mortality. At the lower river flows and slower velocities prevalent in summer when the field studies were conducted, passage time through the plume at the measure velocities would be about 8 minutes with a maximum temperature rise of only a fraction of a degree C. Thus, the combination of temperatures and exposure time would not be sufficient to cause high-temperature mortality. At the higher river flows and channel velocities in spring when these larvae would be present, the travel times would be even faster and the durations of exposure shorter. Also, the temperatures (both ambient and thermal discharge plume) would likely be lower. Thus, I believe the extent of the analysis in the EIS was appropriate. Further information on the thermal plume from field studies is provided by SNC appended to the testimony of Tony Dodd and Matthew Montz.

Q57: Was NRC's analysis of the thermal plume reasonable?

A57: Yes. I believe that the NRC's analysis of the thermal discharge plume for the EIS is reasonable and appropriate. When heated water is discharged into a river, the effluent mixes with surrounding water in a "plume" that is spatially and temporally dynamic, and thus difficult to monitor in field studies. The accepted approach for environmental impact analyses, one established in the initial EISs I participated in for the AEC, is to use computer models based on effluent characteristics and physical principles to estimate the dimensions and concentrations of the progressively diluted constituents (temperature, chemicals) in the plume (Majewski and Miller 1979; IAEA 1980). For its ER, SNC used an EPA-approved mixing model, CORMIX, for its plume analyses. SNC followed the accepted approach of comparing the model's output of time-varying temperatures and chemical constituents in the plume to accepted dose-response data for representative organisms that might encounter the plume. The resulting estimates of no material mortality are reasonable, pertinent, and based on accepted approaches using verifiable methods. In my opinion, the NRC rightly accepted this analysis approach in its independent assessment for the EIS, and came to similar conclusions. However, to assure the Board that the model predictions of plume size and temperatures are reasonable, SNC conducted a field survey of temperature and water velocity at the thermal discharge from units 1 & 2. The study is addressed in the testimony of Tony Dodd and Matt Montz.

Q58: Would you summarize the results of that study.

A58: A monitoring study was undertaken by Mr. Dodd and co-workers in August 2008 to map the temperatures and water velocities in the plume from units 1 & 2. I participated in development of the study plan. Water velocities indicate the location of the momentum-driven effluent discharge path, whereas temperature elevations above the ambient river temperature are of particular interest for thermal impacts to organisms. The study was conducted in the summer

when the river flow was low and ambient river temperatures high. It was expected that the discharge temperature would also be high because both units were operating. As it turned out, the thermal discharge from the cooling tower basin was nearly equal to the ambient river temperature (the difference being less than a degree Centigrade). Both actual flow and temperature conditions were less severe than the more extreme values modeled in the EIS. Temperature rise above the river temperature immediately upstream was detectable in only a small zone, approximately 100 ft long by 75 feet wide immediately downstream of the outfall. Significantly, a large zone of water at temperatures as warm as the thermal plume was identified along the opposite shore extending about 2,400 feet downstream from a point upstream of the thermal discharge and extending fully across the river beginning about 700 feet downstream from the thermal discharge (see figures in the report). The warmest water was at the surface and along the far shoreline, indicating that the source of heat was solar radiation. Thus, at summer conditions of low flow and high ambient river temperatures, the actual warming of the river by the thermal plume was no greater (and apparently much less) than the natural solar heating.

Because the effluent temperature (as measured at the cooling tower basin) was close to the ambient river temperature, the plume could only be identified by velocities. Only a small thermal plume was discernable. A zone of velocities higher than the ambient river velocity was detected immediately downstream of the outfall (within about 25 feet). Beyond that point, there were patches of slightly higher velocity (fractions of a foot per second), one centered about 250 ft downstream of the outfall, one centered about 700 ft downstream, and a third about 1,000 ft downstream. The patches became broader, more in the center of the river, and with velocities less elevated from the surrounding water the farther downstream. They move downstream at about 2.5 ft/s amidst an ambient flow of about 1.8 ft/s, thus covering the surveyed reach of about

1,200 ft in about 8 minutes. My interpretation of these data is that the far-field thermal plume merges with the river water as pulses that move downstream with the river current and progressively mix with the ambient river water. Each pulse or patch is surrounded by water flowing at rates similar to the river upstream of the thermal discharge.

Q59: What is the significance of this field study for the impacts of the thermal discharge on aquatic organisms?

A59: The thermal distributions suggest that exposure to elevated temperatures in the plume would be no greater in midsummer than organisms already receive from natural warming of the ambient surroundings. The velocity distributions suggest that the plume is widely dispersed downstream and is mainly in the center channel rather than impacting the more biologically productive shorelines. Passage and cooling are rapid, almost certainly not providing durations of exposure to high temperatures sufficient to cause mortality in the river. For example, it would take 30 min exposure of striped bass larvae to temperature elevations of 15°F above ambient of 65°F (18.3°C) to cause mortality, (based on the scientific literature) whereas, as I estimated above, water and drifting organisms would pass through the entire surveyed plume in about 8 minutes. I believe this confirms the conclusions reached from the CORMIX modeling, from which the NRC determined the impacts would be SMALL.

Q60: Do you agree with Dr. Young's assertion that the EIS should have included field studies on the existing units' thermal plume?

A60: No.

Q61: What is the basis for your conclusion?

A61: As noted in answer to a previous question, it is not necessary to have site-specific field studies to make reasonable, scientific conclusions. This is especially true when the

estimated impact is small and the methods to estimate this impact level are reliable and based on sound information. The CORMIX model is EPA approved and reliable as long as the assumptions driving it are reasonable. In my opinion, the design of the discharge, discharge temperatures and configuration of the river ensure that the thermal plume is small relative to the river and heat dissipation (and temperature decline) rapid. This rapidly dissipating plume ensures that any organisms passing through it would experience only brief and non-damaging temperature transients. Furthermore, the plume would be even more rapidly dispersed during the normal spring-early summer seasons of ichthyoplankton abundance when river flows are normally high. SNC has conducted a field study which confirms the general size and shape of the plume to provide additional assurance for the Board (a summary is included in the testimony of Matthew Montz). I have reviewed the results and believe that the methods and conclusions are reasonable and appropriate.

Q62: Is it appropriate for the EIS to consider the results from the NRC staff's visit on March 8, 2007 and March 19, 2008, during which larval fish sampling and screen basket cleanings were observed?

A62: Yes. Site visits are important for an analyst to obtain a perspective of the facility in its geographic setting, and to put the proposals in context. I participated in such a site visit, as described above. These site observations are just one of the many sources of information considered in the EIS.

VI. RESPONSE TO SPECIFIC BASES OF CONTENTION EC 1.2 REGARDING RIVER FLOWS AND UNIFORMLY DISTRIBUTED DRIFT COMMUNITY

Q63: Do you agree with Dr. Young's assertion that the EIS does not calculate worst-case scenarios for quantifying entrainment or thermal impacts including the use of 7Q10 flow to analyze entrainment?

A63: No.

Q64: What is the basis for your conclusion?

A64: The EIS considers "worst case" conditions in terms of actual low flows under the Corps' Drought Contingency Plan for the regulated Savannah River and selected low flows rather than 7Q10 calculations (i.e., the flow that would occur for 7 consecutive days once in 10 years) (EIS at 5-30 and 5-33). It uses the Drought Level 3 flow of 3,800 cfs and also uses a streamflow of 2,000 cfs, which is about half of that (Errata of September 3, 2008 for EIS at 5-20). The 7Q10 flows are rather meaningless in this situation because they are statistical calculations based on a long-term flow record, which does not exist for the Savannah River as it is now regulated by the Corps' dams. Having worked on regulated rivers where the flows are often quite different from historical unregulated flows, I consider the approach in the EIS of selecting an extreme low flow (e.g., Errata for EIS at 5-20) more reliable than a questionable 7Q10 under the regulated flow regime currently in place.

Q65: Do you agree with Dr. Young's assertion that the EIS does not use maximum withdrawal rates from the existing units to analyze cumulative withdrawals?

A65: Yes.

Q66: Is this a problem with the NRC's analysis?

A66: No. The cumulative impacts analysis is still reliable. Dr. Young says that impacts could be 7% and the analysis in section 7 on cumulative impacts estimates 6.5%. These differences would not change the conclusion. First, Dr. Young's figure is based on withdrawals,

whereas the EIS uses consumptive use totals for its calculations. Also, it is reasonable to evaluate impacts on more likely situations rather than an unlikely and largely hypothetical maximum. See EIS at 7-4 to 7-7. Simultaneous maximum withdrawal, by all four units, during record low flows, is not likely to happen in actual operation.

Q67: Are the extremely low flows (Category 4) that Dr. Young asserts should have been used for analyses of impacts from entrainment and thermal discharges (Young Affidavit November 13, 2007, page 12, ¶16) likely to occur at times of the year when detrimental entrainment and thermal discharges are most likely?

A67: No, the low river flows are not likely to coincide with high entrainment or risks from high temperatures.

Q68: Why is this so?

A68: The annual low flows occur in the fall of the year (EIS Figure 2-5). The record low flow cited by Dr. Young (3,220 cfs) occurred in December (EIS, at 2-16). In contrast, most entrainable life stages of fish and invertebrates (drifting eggs and larvae) are present in the spring and early summer months when river flows are usually high (as acknowledged by Dr. Young (Affidavit November 13, 2007, ¶ 27)). These eggs and larvae are mainly the products of spring migrations of marine or estuarine American shad, blueback herring, striped bass, and sturgeon species as well as spring spawning by several resident sucker species, freshwater shad species and sunfishes, as identified in earlier studies of drift organisms at the Vogtle site by Wiltz (1983) and Nichols (1983) noted above. These spring periods of drifting early life stages concurrent with high river flows has been documented both generally for most rivers and for the Savannah River in particular (e.g., Paller and co-authors' studies for the Savannah River site, cited in the EIS at 5-104). The field study conducted by SNC and discussed in response to Q44 documents

the spring pulse of entrainable life stages with the concurrent high river flows. For instance, peak organism density in river drift was observed, from April 23 to May 8 (Figure 4-1 of SNC's spring 2008 entrainment study; SNC 2008a). At this time, river flows fluctuated near 4,500 cfs even in this drought year (Figure 4-1). Many drift organisms passed when flows were as high as 8,000 cfs in mid April. The study also verifies the scientifically based assumptions by NRC staff in the EIS.

Q69: Despite the low likelihood that Level 4 low flows would occur at times of high entrainment or high thermal risk, has the NRC staff included analyses of low-flow scenarios in the EIS below Drought Level 3?

A69: Yes, it has.

Q70: What analyses has it conducted and what are the results?

A70: The NRC staff determined that it was conservative to use the 3,800 cfs Drought Level 3 flow in the EIS, but also considered river flows of 3,000 and 2,000 cfs, well below both the minimum flow for Drought Levels 1-3 in the current Drought Contingency Plan and also below 3,220 cfs, the record low flow cited by Dr. Young. At these flows, the maximum consumptive use would be 2.1% and 3.2% of river flow, respectively (EIS at 5-9). The EIS infers from runs for the CORMIX thermal plume model at 3,800 cfs and the calculated cross section of the river at the extreme low flows of 3,000 and 2,000 cfs that thermal plume dimensions for similar temperatures would still be a small percentage of the river and effects not significant (EIS at 5-38 and Errata at 5-20). I agree with this conclusion.

Q71: Are the criticisms by Dr. Young (Affidavit November 13, 2007, ¶ 26, 28) and Mr. Sulkin (Affidavit November 13, 2007, ¶ 12) that water release data from J. Strom

Thurmond Dam are not completely accurate for the Vogtle site a reason for concern for estimates of the effects of entrainment and impingement or thermal discharge?

A71: No, they are not a reason for concern with the analysis.

Q72: Why are they not a concern?

A72: The Savannah River between J. Strom Thurmond Dam and the Vogtle site is monitored by two USGS gauging stations, plus one at the Vogtle site, as detailed in the EIS (at 2-32). There is also a gauging station downstream of the Vogtle site. Regulation of flows for benefit of users such as the Vogtle facility can be monitored closely by the Corps and factored into their release schedules at J. Strom Thurmond Dam. Considering the accuracy of the USGS gauges in contrast to the accuracy of the releases at J. Strom Thurmond Dam (EIS at E-45), analyses in the EIS of river discharge data from these monitoring stations show that the releases at J. Strom Thurmond Dam are a reasonable surrogate for flows at the Vogtle site, despite some marginal water withdrawals and input from tributary streams and groundwater. I do not believe it is necessary for the EIS to require the flow data to be extremely precise and accurate, considering that almost all potential entrainment to drifting organisms would occur in spring when river flows are generally high and not when river flows are low.

Q73: Are the scientific references cited by Dr. Young in support of his disagreement (Young Affidavit November 13, 2007, page 5, ¶ 12) with the NRC staff's assertion (Joint Affidavit ¶ 16) that fish and shellfish can adapt to varying flow regimes and velocities germane to the Vogtle ESP EIS?

A73: No, they are not germane and instead are misleading.

Q74: Why is this so?

A74: The references deal almost exclusively with large changes in flows and velocities induced by dams. The impoundments inundate riverine habitat. The dams' variable hydropower releases create an alternating pattern of streambed scouring and dewatering by large-scale and intermittent changes in flows in tailwaters downstream of the dam, as well as cold summer temperatures from hypolimnetic discharges. These alterations of flow-velocity habitats (some go from no discharge to full river flow in a daily cycle) are of far greater magnitude than expected reductions of Savannah River flows by the proposed units 3 and 4 alone (2.6 to 4.0% change in river volume at 3,220 cfs according to Sulkin Affidavit of November 13, 2007 at ¶ 19) or cumulative effects of all four units (up to 7.9% change according to Sulkin). These figures from the intervenors are larger than those in the EIS (at 5-8 and 5-9); however, the EIS calculates effects based on consumptive use, while intervenors' calculations are based on withdrawals. Also, water extractions for the Plant Vogtle cooling systems are generally continuous rather than intermittent, yielding stable river flows of slightly reduced magnitude rather than the rapidly changing flows addressed in the articles cited by Dr. Young.

Q75: In your opinion, what levels of river flow should be used in models to estimate the size and impact of the thermal plume in the vicinity of the Vogtle site?

A75: For purposes of estimating impacts to drifting early life stages of fish, the most realistic flows to use would be those that occur during the drift period of March through July, when flows are generally high (EIS Fig. 2-5 at 2-19). It is helpful, however, to also use flows that represent low-flow conditions when the thermal discharge would be the largest proportion of the river flow, regardless of whether drifting organisms occur at that time. For estimating thermal impacts to less mobile bottom or shoreline organisms, it is generally most appropriate to use the low flows of summer when river temperatures are highest.

In my opinion, both should generally be used, and the ER and EIS did use both. One low-flow condition was 3,800 cfs, which was not the lowest flow on record, but representative of low flows for the Corps' Drought Contingency Plan. The EIS also assessed a flow nearly half of that, 2,000 cfs (Errata for EIS at 5-20). If the analysis indicates little or no biological impact to the hypothetical drifting or bottom organisms from these low-flow conditions (as it did), then one can be assured that the impacts at higher flows would also be acceptable. Although lower flows are theoretically possible, use of these flows would not change the conclusions reached, in my opinion, and it would not be useful to assess such unlikely hypothetical extremes.

Q76: Do the water levels used in the EIS to model the thermal plume properly and accurately reflect expected impacts?

A76: I believe they do.

Q77: What is the basis for your opinion?

A77: The river flows used in the analysis are highly representative of the range of flows at the Vogtle site.

Q78: Is it appropriate for NRC to use estimates of a uniformly distributed drift community in the Savannah River?

A78: Yes. This is a reasonable and conservative assumption for estimating entrainment impacts based on a large percentage of the fish populations. Rather than using spatially-and temporally-variable numbers of several entrainable species and life stages, such as one would find in most river surveys, an analyst usually takes a single high-end estimate of numbers, assumes them to be the same for all entrained water, and makes an evaluation of the scale of likely impact. The details of distribution would generally come into play only if a moderate to large impact appears to occur and further, more detailed, analyses are warranted.

This detail is not warranted for Plant Vogtle. The EIS concludes very clearly that the impacts are SMALL. As the EIS discusses (at 5-30 to 5-31), there are several design features of the cooling system at Vogtle (both existing and proposed units) that ensure that the numbers of drifting organisms entrained are actually less than what one would calculate from a uniform distribution and entrainment in proportion to water volume. These features are discussed below in response to Dr. Young's assertions concerning the studies of fish eggs and larvae and invertebrate drift by Wiltz and Nichols. Many fish species have eggs laid in nests or are adhesive and these eggs do not enter the drift. Drifting larvae of these and other species are known to be most abundant in back channels, oxbows and tributaries where spawning occurs and nursery areas are prevalent (see EIS at 2-81). The bulk of the drift in the main channel near the Vogtle site is composed of shad eggs and larvae.

SNC and NRC used existing evidence of spatial variability in drift densities to select a hypothetical, conservative uniform density for purposes of estimating impacts. SNC's and NRC's estimates of slight impact are reasonable based on this analytical approach. As a confirmation for the Board of the reliability of this approach, SNC has conducted an entrainment study in the river and in the Vogtle units 1 and 2 intake canal in spring and summer 2008, which is appended to the testimony of Mr. Montz. I have reviewed the report (as discussed above in response to Questions 44 and 45), which concludes that entrainment impacts to riverine ichthyoplankton would be very small and insignificant and I believe that these conclusions are appropriate and confirm the assessment in the EIS.

Q79: Do you agree with Dr. Young's assertion that the EIS should have assumed non-uniform drift community distribution?

A79: No. The assumption of uniform distribution of drift organisms is a common, conservative assumption that takes into account spatial variability. Rather than using field data with the usual complicating spatial and temporal variability, a hypothetical uniform value is taken for the first cut analysis to estimate the scope of impacts. This is conservative because, as the EIS states on 5-30 – 5-31, there are several design features of the intake that minimize the likelihood of entrainment, yet the EIS evaluated entrainment on the basis of a uniform density in the source water and entrainment in proportion to water withdrawal. Use of drift numbers in the source water for the analysis has proven to be especially conservative based on the results of the SNC's 2008 field studies, which showed the numbers of drifting organisms in the intake canal to be below the numbers in the river and to have a different species composition. With the low level of estimated impact on river drift organisms from this hypothetical case, it would not be necessary to refine the calculations further by using empirical data on spatial variability. This spatial variability, as measured in field surveys, would likely be transient and less reliable than a simplifying assumption of uniform (or average) distribution in any event.

Additionally, the distribution and abundance of planktonic organisms such as fish eggs and larvae in aquatic systems are prime examples of features that are notoriously variable. Sampling of the Savannah River near the Vogtle site has confirmed this variability (Paller et al. 1995). Even though Paller et al. were able to use statistical methods to account for variability in their fish egg and larval data, they acknowledge that field data could differ at other sampling times and places.

In sum, it is good and proper science to assume uniformity, and the conclusion that impacts to the drift community would be SMALL is reasonable and supported by the analysis in the EIS. A possible, more-detailed revision which might arise from assessing variability in the

densities (which would likely show less impact) would not be helpful for the purposes of the NEPA assessment.

Q80: Have you reviewed the studies cited by Dr. Young for his assertion that the drift community in the vicinity of the Vogtle site was not uniformly distributed (by Wiltz and by Nichols)?

A80: Yes. I have reviewed the two studies published in 1983, one by J. Wayne Wiltz and the other by M. C. Nichols.

Q81: Do these studies negate the approach used in the EIS?

A81: No. I disagree with the implication from Dr. Young that the assumption used in the EIS is invalid because of these studies. Instead, the EIS's conclusion that impacts will be SMALL is correct.

Wiltz studied egg and larval fish in the Savannah River at the Vogtle site in January through August 1974 in preparation for the Units 1 & 2 operating license. There were three transects for planikton nets, each with stations near the shorelines. He found differences between day and night and some differences between locations, but mostly differences in the seasonal timing of species occurrence (as is typical of coastal plain rivers). Collections on early dates were dominated by larvae of black and white crappie (panfish) and larvae of spotted sucker. American shad appeared in March and peaked in May. Although river discharge was not given, the sampling period was during the high-flow season. The author noted that eggs and larvae were rarely found in the intake canal samples. He stated that the intake velocity would be low enough that eggs and larvae would likely settle out in the intake canal and not be entrained. He stated that fish eggs tend to drift low in the water column. He did not recognize that there would

be a 1-ft-high weir at the bottom of the intake canal to minimize the entry of eggs and larvae that drift near the bottom.

Similarly, Nichols studied the drift of macroinvertebrates occurring 6 to 12 inches off the bottom near the river sides near the Vogtle site for a year in 1980-81, mostly finding aquatic worms and aquatic stages of insects with a scattering of mollusks and crustaceans. As is typical of drift of invertebrates in rivers, the numbers and taxa caught varied seasonally, by time of day, and among locations. High densities generally coincided with high river flows, as also is typical of invertebrate drift.

The EIS notes several design features of the intake that would minimize the entrainment of drifting fish eggs, larvae and bottom organisms (EIS at 5-30 to 5-32). These include: (1) closed-cycle cooling, which minimizes water use (and entrainment) compared to an open-cycle system, (2) low percentage of the river water being withdrawn, especially in the spring high-water months (January through May) when nearly all egg and larval drift occurs and there is the most invertebrate drift, thus affecting a small percentage of all drifting organisms, (3) an intake canal perpendicular to the flow of the river channel that has less likelihood of drawing in drifting organisms, (4) low intake canal velocity that allows drifters to settle and not be entrained in the cooling water, and (5) a 1-ft-high weir at the bottom of the intake canal entrance that is intended to minimize withdrawal of the deeper layers of the river that contain the highest concentrations of the drifting eggs, larvae and invertebrates.

In my opinion, the assumption in the EIS (at 5-31) that the drifting eggs, larvae and invertebrates in the river would be uniformly distributed and all vulnerable to entrainment in proportion to water withdrawal is almost certainly an overestimate rather than an underestimate

of true entrainment, based on the data and discussion in the papers by Wiltz and Nichols. This has been affirmed by SNC's 2008 drift studies.

Q82: Is SNC000013, identified in this pre-filed written testimony, a true, accurate and correct copy of your Literature References, and does it accurately portray the facts is purports to portray?

A82. Yes.

Q83: Are the scholarly or learned journals, articles or treatises referenced in this pre-filed written testimony of the type commonly relied upon in your profession?

A83. Yes.

Q84: Does this conclude your testimony?

A84: Yes.

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of	)	Docket No. 52-011-ESP
	)	
Southern Nuclear Operating Company	)	ASLBP No. 07-850-01-ESP-BD01
	)	
(Early Site Permit for Vogtle ESP Site)	)	January 9, 2009

AFFIDAVIT OF DR. CHARLES C. COUTANT IN SUPPORT OF SOUTHERN NUCLEAR'S PRE-FILED TESTIMONY ON ENVIRONMENTAL CONTENTION 1.2

I, Dr. Charles C. Coutant, do hereby state as follows:

1. I am a retired Distinguished Research Staff Member of the Oak Ridge National Laboratory. A statement of my professional qualifications is attached to the SNC pre-filed testimony to be submitted on January 9, 2009, in response to hearing issues identified by the Board.

2. I have read the foregoing prepared testimony regarding environmental matters at the Plant Vogtle Site.

3. I attest to the accuracy of those statements, support them as my own, and endorse their introduction into the record of this proceeding. I declare under penalty of perjury that those statements, and my statements in this affidavit, are true and correct to the best of my knowledge, information and belief.

Charles C. Coutant
Dr. Charles C. Coutant

ANGIE GRAY
STATE OF TENNESSEE NOTARY PUBLIC
ANDERSON COUNTY

Subscribed and sworn to before me this 23 day of December, 2008.

Angie Gray
Notary Public
Comm exp 08/25/2010